PB-215090

PROGRESS REPORT OF TASTE AND ODOR STUDY BEING CONDUCTED AT THE ENVIRONMENTAL HEALTH CENTER, CINCINNATI, OHIO

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Environmental Health Center
Cincinnati, Ohio

1965

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PB 215 090

Progress Report of Taste and Odor Study Being Conducted at the Environmental Health Center, Cincinnati, Ohio

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Introduction

Extensive abnormal tastes and odors have occurred during the past several years in many public water supplies using the Ohio River and its tributaries as sources of water. A visit to a number of the water plants from Pittsburgh to Cincinnati in December 1948 confirmed that most water plants in this section experienced pronounced taste and odor problems in October and November of 1948. The periodic recurrence of objectionable tastes and odors in these waters has caused much concern to consumers and to water works and health officials. An appeal was made to the Surgeon General of the U. S. Public Health Service for assistance in locating the source, identifying the materials and devising possible methods for the control or elimination of the taste producing substances in the waters of the Ohio River and other streams so affected. Early in 1949 a study of this problem was instituted by the staff of the Environmental Health Center at Cincinnati, Ohio. Much of the work is still in the exploratory research and development stage. This progress report is presented as a matter of information concerning the findings of the study to September 1949 which may be of interest to those concerned with taste and odor problems.

The Ohio River is one of the most extensively used large streams in the United States. It is the source of 33 public water supplies, two of which are Cincinnati and Louisville. The availability of water and cheap transportation have led to the location of numerous industrial plants along its banks.

Until recently, the interstate character of this river has seriously impaired any attempt to eliminate the uncontrolled discharge of industrial and domestic wastes into its waters. Consequently, substantial amounts of a large variety of such wastes, in most cases without treatment, are discharged into the Ohio River and its tributaries. As a result of this pollution many of the modern water filtration plants drawing water from the Ohio River have great difficulty in providing sufficient treatment to supply a water that is free from objectionable tastes and odors.

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Very little is known concerning the specific chemical compounds which cause taste and odor. It is believed that certain tastes and odors are due to the presence of one or more stable organic chemicals present in the finished water in definite but minute amounts. The most likely sources of these chemicals are industrial and domestic wastes entering the river at many points along its course. In addition seasonal blooms of algae or other aquatic vegetation may give rise to tastes and odors. Due to seasonal upheavals of the river bottom, tastes and odors might conceivably occur from the products of organic decomposition of the river muds. The evidence collected to date, however, does not indicate that material of humic origin on the river bottom is a likely source of tastes and odors. Identification of the taste and odor producing substances in water has progressed slowly due to the lack of suitable analytical methods for the detection of the minute amounts of such compounds ordinarily present in water.

Purpose of Study

It is the purpose of the present project to isolate and identify the organic impurities in natural waters polluted by industrial wastes, domestic wastes and aquatic growths. Many of these compounds are believed to cause objectionable tastes and odors in drinking water.

Information on the chemical identity of specific organic substances may provide a means for tracing a specific waste component to a specific source. In addition the rates of natural purification and the effect of present water treatment processes on these organic impurities can be studied. Once the taste and odor agents can be isolated and identified, effective treatment methods for wastes or water at the source may be studied more easily.

Method of Study

In order to isolate and identify those agents responsible for tastes and odors in finished water, a simple and practicable method for their concentration is necessary. Methods considered in this study for such concentration were distillation, extraction by organic solvents and adsorption followed by extraction. Distillation and extraction were found to be impracticable concentration methods. Activated carbon, which is widely used in taste and odor control, was suggested as a practicable adsorbent for this work. An old activated carbon filter used intermittently for about one year to dechlorinate city water prior to distillation at this laboratory was available. The

carbon from the filter was air dried and extracted with anhydrous ether. Approximately 5000 grams of carbon yielded two grams of an anhydrous residue of foul smell.

On the basis of this experience, portable carbon filters were constructed for use in the field. These filters consisted of three foot lengths of four inch pipe charged with granular activated carbon held in place by a screen at each end.

After obtaining clearance through the several state Boards of Health concerned, and securing the cooperation of those in charge of the individual water works, a filter was installed at each of eleven selected water works drawing water from the Ohio River or a tributary of major concern. In general, each filter was installed to receive rapid sand filter effluent. This was to prevent clogging, also to maintain a silt free surface and thus maximum adsorptive capacity of the carbon. Wherever practicable, the flow through the installation was metered to provide a basis for quantitative calculation of the various impurities present. It is believed desirable to pass raw water through the filter. An experimental unit has been constructed to provide pre-filtration of highly turbid waters ahead of the activated carbon unit. A Roberts' stone filter was tried as a pre-treatment unit at Cincinnati but proved unsatisfactory for this purpose.

When the activated carbon filters are returned to the laboratory, the carbon is removed and air dried. It is then extracted in a modified Soxhlet extractor with anhydrous diethyl ether. The ether extract is evaporated to a small volume, dried over anhydrous sodium sulphate, and filtered. The filtrate is evaporated under reduced pressure to dryness in a tared flask. The contents are weighed and recorded as the total ether extractable material.

The extract is redissolved in ether and separated into five or more organic classes as follows:

Class 1 - Primary, secondary and tertiary organic amines.

Class 2 - Amphoteric compounds including high molecular weight aliphatic amino-acids and amino-phenols.

Class 3 - Neutral compounds such as ketones, alcohols, esters and hydrocarbons.

Class 4 - Phenolic compounds and mercaptans.

Class 5 - Strong organic acids and substituted phenols.

Work is progressing on the further breaking down of these classes into their specific organic constituents by micro-analytical techniques. Many procedures and methods have to be developed or adapted for these determinations.

The quantities of other extractible materials obtained from filters located in several cities are given below.

City	Days Filter was in service	Metered Flow through filter	Influent to carbon filter	Weight of ether extract	Concentration of total organics extracted
		Gallons		Milligrams	Parts per Billion
Cincinnati,O.	35	4,380	Raw water	485	29.3
Huntington,W.Va	53	23,550	Finished water	1,794	21.0
Louisville,Ky.	111	28,043	Filter effluent	1,162	10.7
Midland, Pa.	150	19,275	Filter effluent	1,275	17.5
Nitro, W.Va.	-	-	Filter effluent	1,700	-
Pomeroy, O.	107	40,000	Filter effluent	1,417	9.3
Wheeling,W.Va.	187	20,560	Filter effluent	1,576	21.0

The problems involved in this study are complex and time-consuming. It is believed that such studies are fundamental to the solution of taste and odor difficulties in drinking water. It is hoped the present study when complete will furnish useful information to water treatment plant operators and others in the field of public water supply.